Behavioral and Morphological Mimicry in a Cranefly and an Ichneumonid

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Field observations in Costa Rica (Slobodchikoff, unpublished), Mexico (P. Arnaud, personal communication), and Arizona (J. Wick, personal communication) suggest that mimetic relationships between craneflies and hymenopterans are fairly common. However, apparently such relationships have not been described (C. P. Alexander, personal communication) nor have such relationships been subjected to experimentation to determine whether Batesian or Müllerian mimicry is involved. The purpose of this paper is to describe an apparent mimetic situation between a crane fly, *Ctenophora vittata angustipennis* Loew, and an ichneumonid wasp, *Therion circumflexum* (L).

The observations reported here were made at Alpine Lake, Marin County, California, during May of 1971–1973. The vegetation surrounding Alpine Lake may be described as mixed coniferous forest interspersed with small patches of oak-grassland. Occasional streams are present, draining into Alpine Lake. The oaks in the oak-grassland are primarily live oaks, *Quercus agrifolia*. Both the cranefly and the ichneumonid are found mainly around the oak trees. Mimicry in these two species apparently involves two factors: similarity in flight behavior and similarity in coloration.

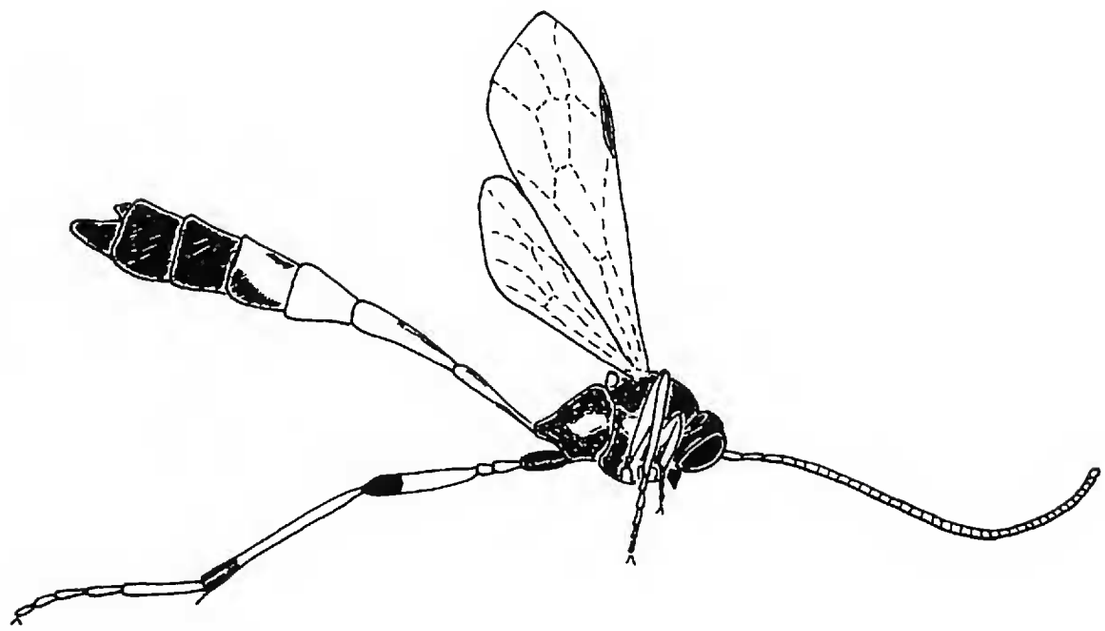
Flight behavior in *Therion circumflexum* has been described by Slobodchikoff (1973). Female *T. circumflexum* fly comparatively slowly, at a speed of approximately 10 cm/sec, about one meter above the top of grass stems in shady areas underneath oak trees. Males, on the other hand, fly twice as fast as females, approximately 20 cm/sec, around the perimeter of the upper three-quarters of the oak canopy. When the male and female ichneumonids fly, their third pair of legs are stretched out 20 degrees below the horizontal plane of the body, their abdomen is held up 20 degrees above the plane of the body, the femora and tibiae of the first pair of legs are pressed close to the thorax, and the femora of the middle legs are pressed to the thorax while the tibiae of the middle legs are held out away from the body. Both the male and female fly with their antennae extended forward.

Male and female craneflies exhibit the same flight patterns as the ichneumonid males. The craneflies fly around the perimeter of oak

canopies, at a speed equivalent to that of male ichneumonids. Males and females both fly with their hind legs stretched out downward and back, and with the abdomen elevated 15 to 20 degrees above the horizontal plane of the body. The middle femora are pressed to the thorax, while the middle tibiae are held away from the body. The front femora are kept pressed to the thorax, while the front tibiae are extended forward, beyond the head, apparently simulating the ichneumonid's antennae. In flight, the craneflies are very difficult to separate from the ichneumonids. Apparently, neither male nor female craneflies mimic the flight behavior of female ichneumonids. No *Ctenophora* have been observed flying at the speed or the level of the female *Therion.*

The similarity in coloration of the ichneumonid and cranefly is very marked. Both the *Therion* and the *Ctenophora* have a yellow, orange, and black overall color pattern. The ichneumonid (fig. 1) has a black thorax, with yellow scutellum dorsally and irregular orange splotches laterally. The head is black, with long orange antennae. The abdomen is orange, with an incomplete black stripe dorsally, and the three terminal abdominal segments are entirely or mostly black. The hind and middle coxae are black, the front coxae are yellow. The hind femora and tibiae are yellow in their proximal 0.7, black in their distal 0.3. The middle and front femora and tibiae are yellow, as are all tarsal segments.

The cranefly (fig. 2) has a black thorax, with faint yellow in the scutellar region and irregular yellow splotches laterally. The head is black, the short antennae are orange. The abdomen is orange, with a longitudinal black stripe dorsally and a reddish-black longitudinal stripe laterally. The basal third of the first abdominal segment is black, creating the illusion of a constriction or petiole when the abdomen is seen in side view against a dark background. The terminal three visible segments of the abdomen are reddish black. All coxae are black, and all trochanters are yellow. The distal ends of the trochanters of the first pair of legs are pointed dorsally, assuming the same position in flight as the yellow coxae of the first pair of legs of *Therion.* All femora and tibiae are yellow-orange in their proximal 0.8, and black in their distal 0.2. When seen against a dark background, such as the dark green of oak leaves, the black on the legs creates the illusion that the legs are shorter than they are in actuality. Even though all the cranefly's legs are longer than the ichneumonid's legs, the cranefly's legs in flight appear to be no longer than those of the ichneumonid. The first tarsal segment of each leg is orange, the remaining tarsal segments are blackish-orange. This also contributes to the illusion of



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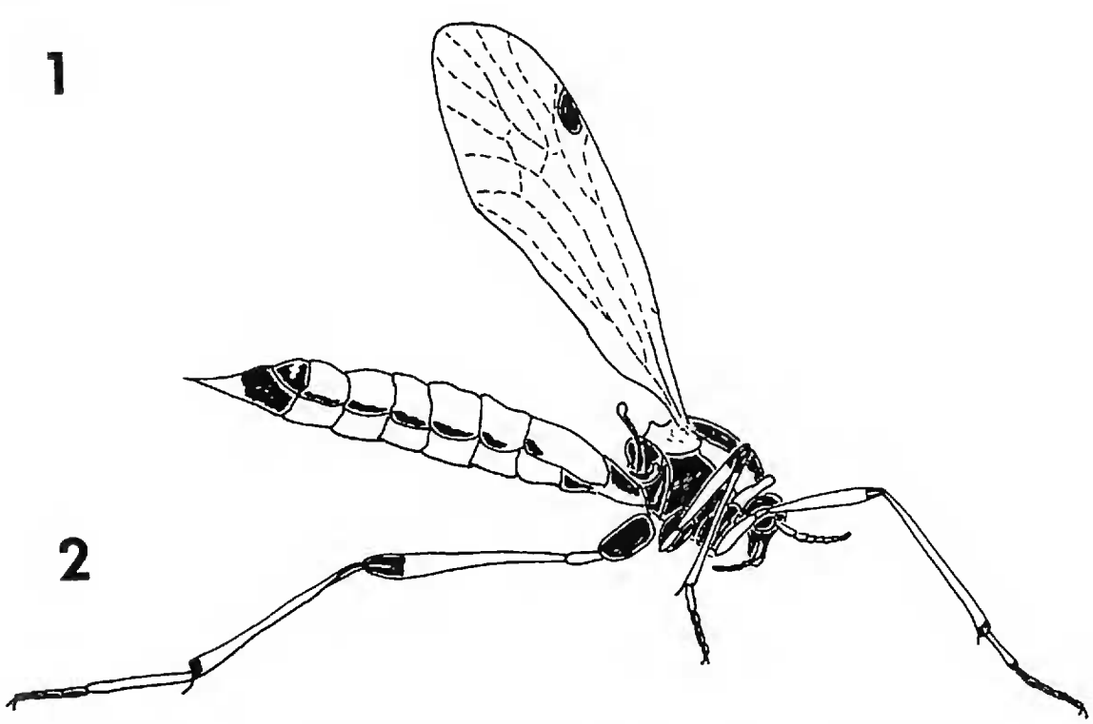

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FIG. 1. Male *T. circumflexum*, lateral view, shown in position of flight.
FIG. 2. Female *C. vittata angustipennis*, lateral view, shown in position adopted during flight.

shorter legs in flight. Since the orange front tibiae are held out in front of the cranefly in flight, an illusion of orange ichneumonid antennae is created.

The geographical distribution of the cranefly coincides with the distribution of the ichneumonid. *Ctenophora vittata angustipennis* has been recorded from British Columbia, Washington, Oregon, and California (Stone *et al.*, 1965). Although *T. circumflexum* occurs through-

out Canada and the United States in transition life zones, 19 percent (31 localities) of the total localities (163) from which *T. circumflexum* has been recorded occur in the Pacific Northwest (Slobodchikoff, 1971).

Neither the *Therion* males nor the *Ctenophora* are present in very large numbers. During May 1971 and May 1972 males of *Therion* and both sexes of the *Ctenophora* were captured, marked with enamel paint, and released. Marking and subsequent attempts at recapture were carried out for 30 days in May 1971, and 21 days in May 1972. A total of 32 male *Therion* were captured, marked, and released in 1971, and 27 were captured, marked, and released in 1972. Seven *Ctenophora* were captured, marked, and released in 1971, and 15 were captured, marked, and released in 1972. In this two year sampling period, *Therion* represented 73 percent of the total number of ichneumonids and craneflies caught, while *Ctenophora* represented 27 percent of the total captures. Each year, after the first 5 days of sampling, more than 50 percent of the *Therion* caught on a given day were recaptures of previously marked individuals. No marked *Ctenophora* have been recaptured.

The mimicry may be either Batesian or Müllerian. The lower percentage of craneflies present suggests that mimicry may be of the Batesian type, with the ichneumonid serving as the model. Protection from predation is probably provided by some distasteful quality. Supporting this conclusion are: 1) male ichneumonids lack an ovipositor that could be used for defensive purposes; 2) both the ichneumonid and cranefly have orange, yellow, and black coloration, colors that frequently have an aposematic function in insects (Rettenmeyer, 1970).

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LITERATURE CITED

RETTENMEYER, C. W. 1970. Insect mimicry. Ann. Rev. Entomol., 15: 43–74.

SLOBODCHIKOFF, C. N. 1971. Patterns of differentiation and evolution in the genus *Therion* (Hymenoptera: Ichneumonidae). Ph.D. dissertation, University of California, Berkeley.

SLOBODCHIKOFF, C. N. 1973. Behavioral studies of three morphotypes of *Therion circumflexum* (L). (Hymenoptera: Ichneumonidae). Pan-Pacific Entomol., 49: 197–206.

STONE, A., C. W. SABROSKY, W. W. WIRTH, R. H. FOOTE, and J. R. COULSON. 1965. A catalog of the Diptera of North America. U.S.D.A. Agriculture Handbook No. 276, 1696 pp.

RECENT LITERATURE

THE ANISODACTYLINES (INSECTA: COLEOPTERA: CARABIDAE: HARPALINI): CLASSIFICATION, EVOLUTION, AND ZOOGEOGRAPHY. GERALD R. NOONAN. Questiones entomologicae, 9: 266–480. 1973.

This revision contains keys to genera and subgenera, with complete taxonomic treatment of *Anisotarus*, *Notobia*, and *Gynandrotarsus*. Nearly 50 pages are devoted to discussion of the zoogeography and phylogeny of the Anisodactylina. The application of Hennig's methods of analysis to a group of insects with no fossil record and few characters which can intrinsically be considered plesiomorphic or apomorphic should be of interest to many systematists.—*Editor.*